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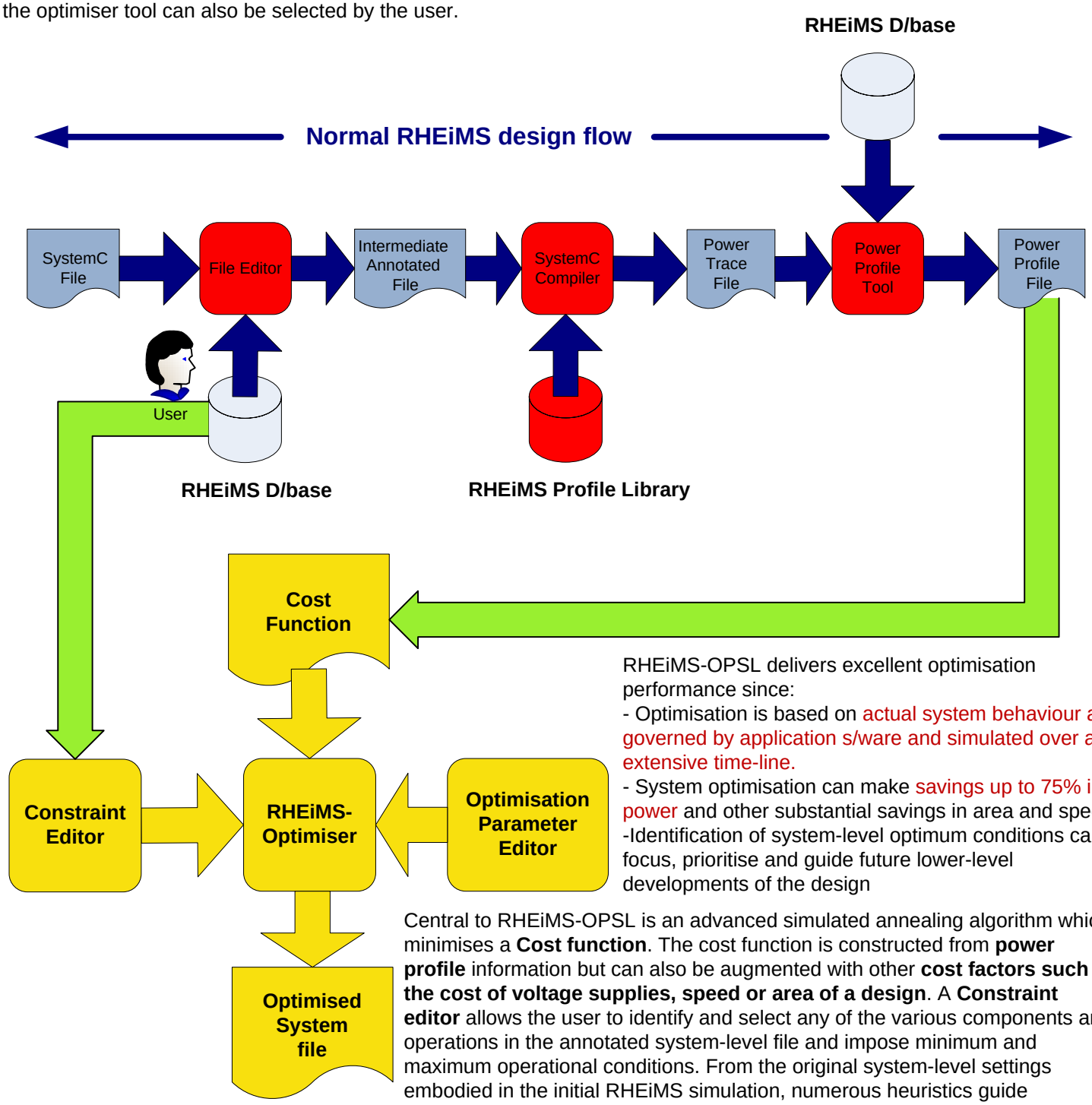
R H E i MS-OPSL

RHEiMS- OPtimisation at System-Level

RHEiMS-OPSL is an extension tool to the RHEiMS design flow. The power profiling generated by RHEiMS gives a very detailed and accurate account of the component activity in the system-level design, their power consumption and that of the entire system, and the duration of their activity. The RHEiMS-OPSL tool uses this profiling information to automate the process of determining the optimum operating conditions for the system-level design, subject to minimising power and/or execution time of the various modules and/or the number of voltage levels(islands) incorporated into the design. In this process, the user has the choice of selecting which of these operating conditions will be optimised and the constraints on one of more modules. Constraints typically define the min/max operational voltage and frequency of a module, and the times of the tasks performed by the modules. Various slow/fast optimisation strategies incorporated into the optimiser tool can also be selected by the user.

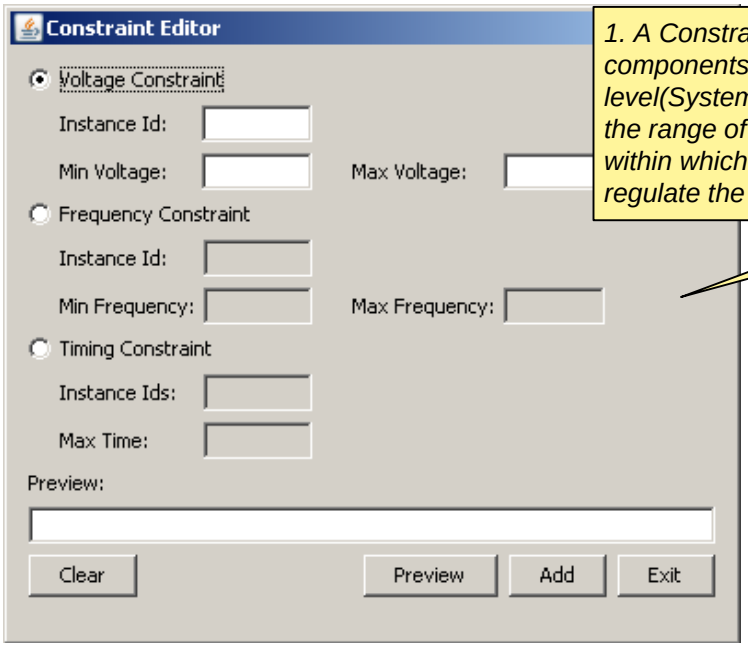


RHEiMS-OPSL delivers excellent optimisation performance since:
- Optimisation is based on actual system behaviour as governed by application s/ware and simulated over an extensive time-line.
- System optimisation can make savings up to 75% in power and other substantial savings in area and speed.
-Identification of system-level optimum conditions can focus, prioritise and guide future lower-level developments of the design

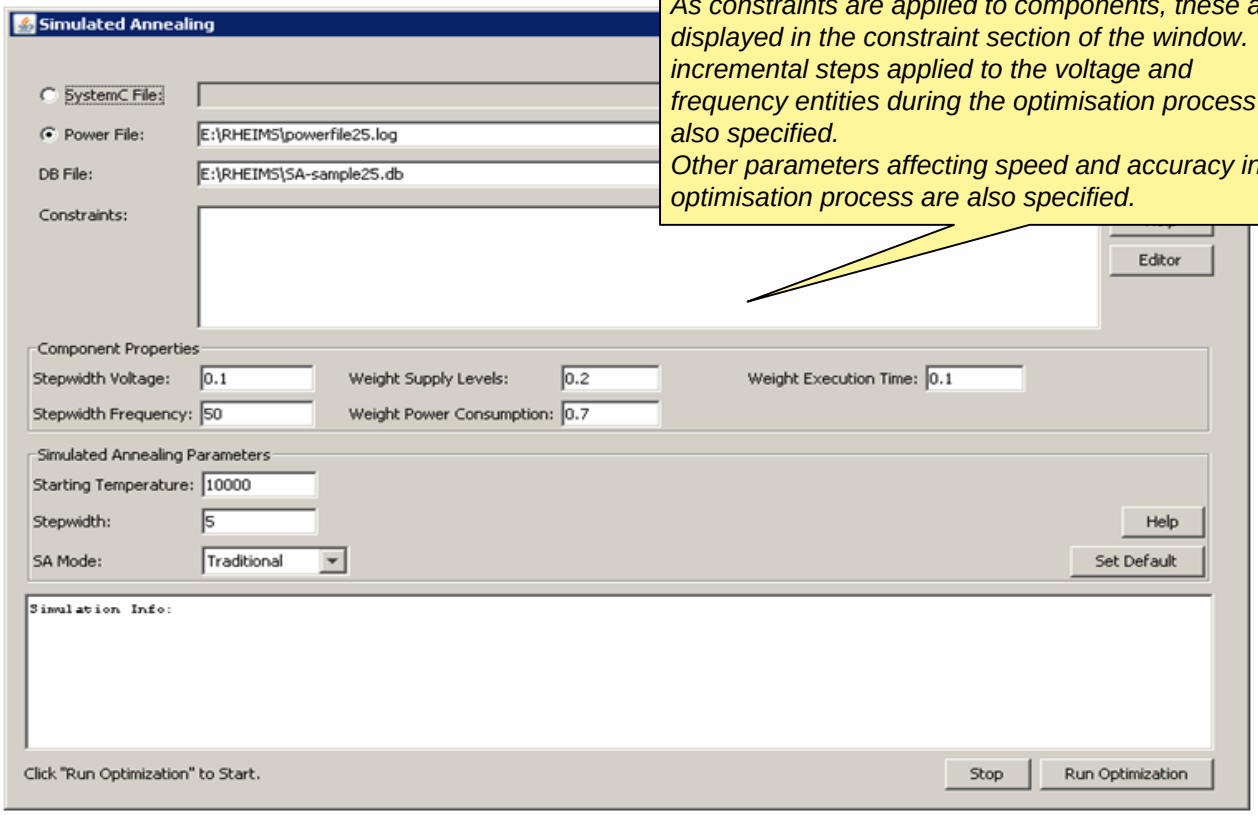
Central to RHEiMS-OPSL is an advanced simulated annealing algorithm which minimises a **Cost function**. The cost function is constructed from **power profile** information but can also be augmented with other **cost factors such as the cost of voltage supplies, speed or area of a design**. A **Constraint editor** allows the user to identify and select any of the various components and operations in the annotated system-level file and impose minimum and maximum operational conditions. From the original system-level settings embodied in the initial RHEiMS simulation, numerous heuristics guide successive perturbations in the system-level conditions until a minimum or near minimum in the cost functions is acheived.

A choice of numerous heuristics and parameter settings, employed in the simulation algorithm affecting the resolution of results, can be invoked through the **Optimisation Parameter Editor**. This enables fine-tuning of results after an initial fast and coarse optimisation assessment

The RHEiMS-OPSL GUI



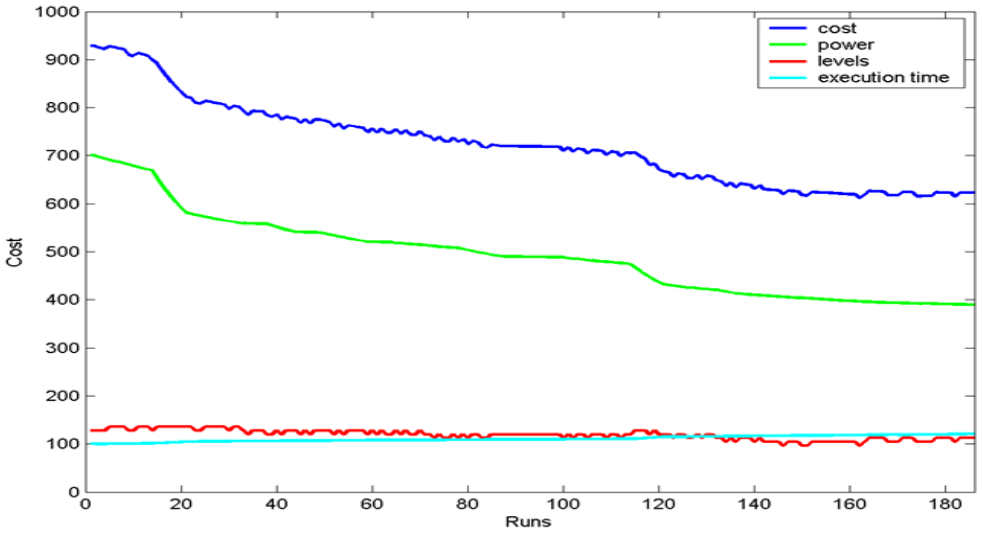
1. A Constraint Editor is used to identify the components and operations in the system-level(SystemC, SystemVerilog etc) simulation file and the range of Voltage, Frequency and Timing values within which they may operate. These constraints regulate the search space explored by the optimiser.



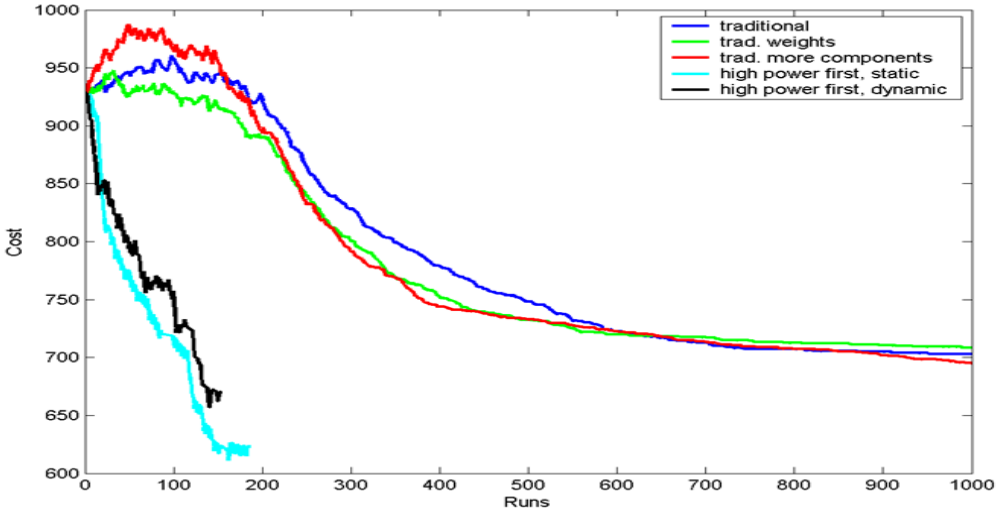
*2. The Simulated Annealing(Optimiser) window is used to select the Power Profiling file *.log and the appropriate database file *.db associated with the simulated SystemC file.*
As constraints are applied to components, these are displayed in the constraint section of the window. The incremental steps applied to the voltage and frequency entities during the optimisation process are also specified.
Other parameters affecting speed and accuracy in the optimisation process are also specified.

The RHEiMS-OPSL Optimisation Analysis

The following output diagram was produced from a system of 25 components with maximum emphasis on reducing power and substantially less significance given to the number of voltage-level(islands) and execution time of the system. RHEiMS-OPSL displays the overall cost function and its constituent contributors. The information displayed indicates that after approximately 180 optimisation iterations a solution was found, subject to the constraints specified in the simulation, that gave a 57% reduction in power without any significant impact on execution time or the number of voltage levels in the design. The set of system operating conditions producing this result are also delivered by the optimiser.



Depending on the main objective of the optimisation and the degree of resolution in the system parameters, there are number of heuristics that can be applied in the optimisation process. In this particular example, the “Best” optimisation algorithm for power reduction is where components are only selected and optimised once in the entire process rather than being possibly re-selected again in later optimisation iterations. After only 190 iterations an optimal solution has be found that exceeds any solution found even after 1000 iterations of any other approach.



RHEiMS-OPSL Value Proposition

RHEiMS-OPSL has the following unique features

- Optimisations are generated from system-level profiles that can involve the execution of application s/ware over extensive simulation time-frames. Thus, the optimisations are guaranteed to improve the general performance of the design.
- The identification of the optimal operating conditions can be used to guide the design development from the system-level through to behavioral and gate-level.
- Optimisation uses the RHEiMS platform ensuring system-level speed and gate-level accuracy.